U.S. Naval Academy
Mechanical Engineering Department
EM415 - Heat Transfer - Fall 2004

FROM: EM415 Course Coordinator
TO: EM415 All Sections
SUBJ: COURSE-WIDE OBJECTIVES AND POLICIES – EM415

TEXT: *Introduction to Heat Transfer,* 4th Ed., by F. P. Incropera and D. P. DeWitt, 2002.

INSTRUCTOR CONTACT INFORMATION:

Sections 3311 and 5511
Associate Professor Ralph Volino
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Sections 2121 and 4321
Assistant Professor Andrew N. Smith
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COURSE OBJECTIVES:
The purpose of this course is to provide each student with a basic understanding of the following topics in Engineering Heat Transfer.

- The Heat Equation
- Steady State and Transient Conduction
- Enhanced Heat Transfer Surfaces (Heat Sinks)
- Forced Convection, Laminar and Turbulent Flow
- Free Convection
- Boiling and Condensation Heat Transfer
- Introduction to Heat Exchanger Design
- Introduction to Radiation

COURSE POLICIES:
General Policies:
(1) In keeping with professional engineering practice, all outside sources of information used for any homework or project submitted in this course must be cited. Outside sources include all sources other than your text, course notes, and the EM415 instructors.
(2) Students are responsible for **all assigned material as well as for information conveyed in class and via handouts and email.**

Homework Policies: Consistent and careful preparation of homework and reading assignments is very important in this course. In that light, the following guidelines **will be** enforced:
(1) Homework must be submitted in a clear, neat manner. The problem solving approach described in Section 1.4 of the text must be used on homework assignments and exams problems.
(2) Mechanical Engineering or the Green Engineering paper will be used for all homework problems. **Absolutely no more that one problem per page!!!**
(3) Homework problem will be assigned and collected on a weekly basis. Each homework assignment will be worth 5 points.

Laboratory Sessions:

The laboratory sessions will involve computer exercises and experimentation. The material presented and learned in these lab sessions will supplement the material covered in the lectures and should make this class both more educational and enjoyable. All material covered during the laboratory sessions is to be considered testable on a course examination. All laboratory reports will be submitted in the standard Memorandum Format.

Examinations:

There will be three, 1 hour exams, each covering about a third of the course material, and the Final Exam, which will be comprehensive.

(1) You **MUST** receive permission **IN ADVANCE** to be excused from a scheduled exam.
(2) The use of calculators is encouraged.
(3) All exams will be **OPEN Book.**
(4) Calculators and Textbooks **may not** be shared during Exams.

Overall Grade Composition:

3 Exams @ 15% each	45 %
Homework	10 %
Laboratory Reports	15 %
Final Exam	30 %

Course Schedule - Sections 2121 & 4321

8/23	Introduction to Heat Transfer	Ch. 1
8/25	Conservation of Energy	Ch. 1
8/27	Surface Energy Balance	Ch. 1
Lab	Math Review & Intro Experiment (EES/MathCad)	
8/30	Thermal Properties of Matter	Ch. 2
9/1	Heat Diffusion Equation	Ch. 2
9/3	Boundary & Initial Conditions	Ch. 2
Lab	Thermal Conductivity Lab	
9/6	LABOR DAY	
9/8	1-D Steady Conduction – Radial Systems	Ch. 3
9/10	1-D Steady Conduction - Energy Generation	Ch. 3
Lab	Melting Ice Lab	
Extra Lab	1-D Steady Conduction - Plane Wall (EES/MathCad/Excel)	
9/13	Heat Transfer from Extended Surfaces	Ch. 3
9/15	Calculation of Heat Sink Performance (EES/MathCad)	Ch. 3
9/17	Fin Example Problem	Ch. 3
Lab	Heat Sink Lab	
9/20	2- D Steady Conduction	Ch. 4
9/22	Finite Difference Equations	Ch. 4
9/24	Boundary Conditions	Ch. 4
Lab	TEST #1	
9/27	Lumped Capacitance	Ch. 5
9/29	Heisler Charts/ Semi-Infinite Solid	Ch. 5
10/1	HOLIDAY	Ch. 5
Lab	2D Fin Example Problem	
10/4	Explicit Method	Ch. 5
10/6	Implicit Method	Ch. 5
10/8	Introduction to Convection	Ch. 6
Lab	Transient Conduction Lab	
10/11	Boundary Layer Equations	Ch. 6
10/13	External Flow – Flat Plate	Ch. 7
10/15	External Flow – Cylinders and Spheres	Ch. 7
Lab	Flat Plate Computer Module (HHT)	
10/18	Internal Flow - Velocity Profile & Entry Length	Ch. 8
10/20	Internal Flow - Thermal Profile & Entry Length	Ch. 8
10/22	Internal Flow - Energy Balance	Ch. 8
Lab	Design Convection Experiment (EES/MathCad)	

10/25	Internal Flow Correlations	Ch. 8
10/27	Free Convection	Ch. 9
10/29	Free Convection Correlations	Ch. 9
Lab	TEST #2	
11/1	Free Convection Example Problem	
11/3	Pool Boiling	Ch. 10
11/5	Forced Convection Boiling	Ch. 10
Lab	Implement Convection Experiment	
11/8	Heat Exchangers LMTD Method	Ch. 11
11/10	Parallel & Cross Flow	Ch. 11
11/12	Types of Heat Exchangers	Ch. 11
Lab	VETERN'S DAY	
11/15	Heat Exchanger e-NTU Method	Ch. 11
11/17	Heat Exchanger Design Problem	Ch. 11
11/19	Heat Exchanger Design Problem	Ch. 11
Lab	Heat Exchanger Lab	
11/22	Radiation Introduction	Ch. 12
11/24	Blackbody Radiation	Ch. 12
11/26	THANKSGIVING	
Lab	THANKSGIVING	
11/29	Absorption, Reflection and Transmission	Ch. 12
12/1	Radiation View Factors	Ch. 13
12/3	Blackbody Radiation Exchange	Ch. 13
Lab	TEST #3	
12/6	Radiation Exchange Diffuse Gray Surfaces	Ch. 13
12/8	Final Exam Review	Ch. 13
Lab	Radiation Computer Exercise (MathCad/Excel)	

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9/1	Heat Diffusion Equation	Ch. 2
9/3	Boundary & Initial Conditions	Ch. 2
Lab	Thermal Conductivity Lab	
9/6	LABOR DAY	
9/8	1-D Steady Conduction - Plane Wall	Ch. 3
9/10	1-D Steady Conduction (MathCad/EES/Excel)	Ch. 3
9/13	1-D Steady Conduction – Radial Systems	Ch. 3
9/15	1-D Steady Conduction - Energy Generation	Ch. 3
9/17	Heat Transfer from Extended Surfaces	Ch. 3
Lab	Melting Ice Lab	
9/20	Fin Example Problem	Ch. 3
9/22	Calculation of Heat Sink Performance (EES/MathCad)	Ch. 3
9/24	2- D Steady Conduction	Ch. 4
Lab	Heat Sink Lab	
9/27	Finite Difference Equations	Ch. 4
9/29	Boundary Conditions	Ch. 4
10/1	HOLIDAY	
Lab	TEST #1	
10/4	Lumped Capacitance	Ch. 5
10/6	Heisler Charts / Semi-Infinite Solid	Ch. 5
10/8	Explicit Method	Ch. 5
Lab	2D Fin Example Problem (EES)	
10/11	Implicit Method	Ch. 5
10/13	Introduction to Convection	Ch. 6
10/15	Boundary Layer Equations	Ch. 6
Lab	Transient Conduction Lab	
10/18	External Flow – Flat Plate	Ch. 7
10/20	External Flow – Cylinders and Spheres	Ch. 7
10/22	Internal Flow - Velocity Profile & Entry Length	Ch. 8
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10/29	Internal Flow Correlations	Ch. 8
Lab	TEST #2	
11/1	Free Convection	Ch. 9
11/3	Free Convection Correlations	Ch. 9
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11/8	Pool Boiling	Ch. 10
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11/19	Heat Exchanger Design Problem (EES)	Ch. 11
Lab	Heat Exchanger e-NTU Method (EES)	
11/22	Radiation Introduction	Ch. 12
11/24	Blackbody Radiation	Ch. 12
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12/1	Radiation View Factors	Ch. 13
12/3	Blackbody Radiation Exchange	Ch. 13
Lab	Heat Exchanger Lab	
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12/8	Final Exam Review	Ch. 13
Lab	Radiation Computer Exercise (MathCad/Excel)	

EM415 Homework Assignments

Assignment	Due Date	Chapter	Problems Assigned
1	8/27	1	5, 16, 23
2	9/3	1	28, 33, 55 a)&b) (Tsurr = 285K)
		2	12, 13 (use T(x=0)=To)
3	9/10	2	17, 19, 26a)&b), 41
		3	7, 9
4	9/17	3	15, 26, 44, 52, 95a)-c), 119
5	9/24	3	112, 120, 121, 126, 136, 145
6	10/8	4	15, 24, 40, 42, 49a)
		5	6, 8, 34, 45
7	10/15	5	51, 61, 72, 93, 95(explicit & implicit)
		6	1, 12
8	10/22	7	2, 14, 17, 30, 43, 81
9	11/5	8	4, 12, 26, 31a), 32, 88
		9	9, 22a
10	11/12	9	40, 61
		10	5, 23a)
11	11/19	11	2, 10, 16, 38, 53
12	11/24	11	55a, 76a)-c)
13	12/8	12	21, 29a), 44
		13	1, 11, 24, 41, 56, 62